ENTOMOLOGY.—*Two new species of* Rhyopsocus (*Psocoptera*) *from the U. S. A., with notes on the bionomics of one household species.* Kathryn M. Sommerman, Arctic Health Research Center, Public Health Service, Anchorage, Alaska. (Communicated by A. B. Gurney.)

The genus *Rhyopsocus* is currently placed in the family Psoquillidae according to Pearman's classification, 1936, or in Trogiidae following the classification of Roesler, 1944. If we assume that *Rhyopsocus*, *Deipnopsocus*, and *Rhyopsocopsis* are subgeneric categories in the genus *Rhyopsocus*, only one species of this genus is known to occur in the United States, *R.* (*Deipnopsocus*) *texanus* (Banks 1930) described from Brownsville, Tex. A second species, *R. eclipticus* Hagen, 1876, questionably from this country, was collected on Kerguelen Island in October 1874. The following comment is quoted from the original description: "The only specimen noticed during the stay of the Transit Party at Kerguelen was captured October 17, in-doors, and was mounted in balsam on a slide. Shortly before its capture some instrument boxes, brought from Washington and containing a quantity of packing straw, had been unpacked in the same room; a circumstance rendering the habitat of the insect very doubtful at the time. J. H. K." Hagen states that the antennae of this specimen were broken, one having eight basal segments and the other twelve, while an apical section of fourteen segments lay near by on the slide. It seems quite probable that the apical part was broken off the 8-segmented base instead of the 12-segmented one as he assumed.

The characteristics possessed by the species of this genus are: head short and oblique, labial palps 2-segmented, antennae 22-segmented, peg like sense organ on inner side of second segment of maxillary palp, Fig. 1, lacinia bifid, Fig. 2, ocelli usually completely developed in macropterous forms; wings variable in length, forewings rounded apically and possessing stout setae on veins and margin, usually a closed discal cell bounded by R and M and their derivatives (cell sometimes absent, especially in brachypterous forms), Cu usually shorter than Cu_2, in hind wing M not branched; tarsi 3-segmented, claws without preapical tooth, Fig. 3; paraprocts each with a mesad anal spine.

Two species of this genus came to my attention while collecting in the Southeastern States, one of which was taken indoors in small numbers in my house at Orlando, Fla. The latter was living year-round on the bedroom walls, the only walls covered with a water-base paint, in association with a species of the *Liposcelis bostrychophilus* complex and *L. entomophilus* (Enderlein, 1907). This species is of no apparent economic importance but because a study of some of the household psocids was being made at that time, preliminary observations were made on this one too. Unfortunately it was necessary to move before a detailed study of the bionomics could be made so the information is incomplete.

I am indebted to Mr. J. V. Pearman for comparisons and comments regarding these two species and *Rhyopsocopsis peregrinus* Pearman, 1929, and *Deipnopsocus disparilis* Pearman, 1931. Dr. P. J. Darlington examined the types of *eclipticus* and *texanus* and supplied information in answer to my questions. On learning that this paper was in preparation, Dr. A. B. Gurney kindly contributed for study the specimen he had collected in Texas. To each I extend my sincere thanks.

I have not seen specimens of the other species in this genus, and so my comments are based on the original descriptions and on observations made by others. These two new species apparently most closely resemble *R. eclipticus*, but the sex of the type of the latter is not known to me. Brachypterous individuals of these two new species are usually smaller than the macropterous forms and lighter in color. If such is generally true of the species in this genus, then these two species are smaller than *eclipticus*, the brachypterous form of which is larger than the macropterous forms of these two new species. Regardless of the sex of the

type of *D. spheciophilus* Enderlein, 1903, a Peruvian species, available information indicates that it differs from these two in several ways, the most noticeable being: color pattern, absence of setae along the margin of the anal lobe, and presence of rows of scales along the wing margin. Although there is some question concerning the presence of scales on the wings of *texanus* it is likely that the presence of the white hair on the head and legs of this species distinguishes it from these two.

Rhyopsocus bentonae, n. sp.

Figs. 1–12

Length of alcoholic specimens 1.15 to 1.6 mm including wings. Head and thorax of macropterous forms dark brown, antennae, legs and dorsal parts of terminalia light brown, abdomen pale yellow. Corresponding parts of brachypterous forms light golden brown to buff, with abdomen likewise pale yellow. Wing membrane almost hyaline, with a slight fumose tinge. There is considerable variation in wing venation, some veins having extra branches which may anastomose, but in general venation is as shown in Fig. 8.

Dorsal, posterolateral margin of male terminalia with two stout, curved, bluntly pointed and sparsely setose prongs; ventral surface of terminalia with a broad, thin, tail-fin-like flap (hypandrium?) which is a bit asymmetrical, Figs. 6, 11, 12.

Dorsal, anterior margin of female terminalia medianly expanded to form a quadrangular plate bearing a non-pigmented spot; anterior lateral limits of terminalia densely pigmented, much darker than lateral and apical margins of egg-guide; anterior margin of faintly pigmented subgenital plate convex, Figs. 4, 9, 10.

Holotype, macropterous male, Orlando, Fla., October 1953, ex culture, K. M. Sommerman. **Allotype,** same data. These are deposited in my collection. **Paratypes,** four specimens, a macropterous and brachypterous male and female, all same data as above, deposited in each of the collections of the following institutions or individuals: USNM, INHS, MCZ, P. J. Chapman, E. L. Mockford, and J. V. Pearman, and ten of each of the four kinds of individuals in my collection. The following additional distribution records are available, all from Florida: Daytona Beach, Nov. 2, 1941, ex dry palm leaves, A. H. Sommerman, ♂, ♀; Englewood, May 22, 1952, ex Flame vine, A. H. S. ♂; same, but March 13, 1953, ♂, 3 ♀; Orlando, Oct. 1953, ex cultures (original specimens from bedroom walls), many specimens, both sexes, nymphs of all instars, eggs on cotton; same, but July 7, 1954, 6♂, 2♀, 4N; Orlando, Feb. 15, 1954, ex bedroom walls, K. M. S. ♂, 5♀, 4N.

I take pleasure in naming this species after Jimmie Benton, who kindly furnished the materials for construction of the rearing racks. Her active interest in the rearing project concerning the household species was, indeed, stimulating and encouraging.

Rhyopsocus phillipsae, n. sp.

Figs. 13–17

Length of alcoholic specimens 1.1 to 1.5 mm including wings. Overall color similar to *bentonae*. Wings of macropterous forms, Fig. 13, with a more sharply defined, angulated anal lobe, much like that of *peregrinus*.

Dorsal, posterolateral margin of male terminalia with two thin, broad, rounded lobes; ventral surface of terminalia with exposed, median hooklike projection on anterior margin, Figs. 16, 17.

Dorsal, anterior margin of female terminalia medianly with slight expansion cephalad, or if pronounced, more rounded than *bentonae*; anterior lateral limits of terminalia faintly pigmented, much lighter than lateral and apical margins of egg-guide; anterior margin of lightly pigmented subgenital plate concave, Figs. 14, 15.

Holotype, brachypterous male, Valdosta, Ga., State College Campus, Apr. 23, 1955, ex bamboo sheaths, Sommerman and Phillips. **Allotype,** macropterous, same data. These are deposited in my collection. **Paratypes,** a brachypterous male and female, same data, deposited in USNM, brachypterous female, same data but ex ground cover, deposited in my collection. The following additional distribution records are available: Myakka S. Pk., Fla., June 7, 1952, ex Spanish moss, K. M. Sommerman, 3♂, ♀; Hayesville, N. C., Aug. 25, 1954, ex Boxwood, W. E. Snow, 2♂, 2N; same, but Oct. 26, 4♂, 10♀, 5N; 90 miles west of Orange, Tex., Oct. 8, 1951, beating trees, A. B. Gurney, ♂.

It is a privilege to name this species after Grace R. Phillips, who helped collect the type material and who has contributed other interesting specimens and records to my collection.

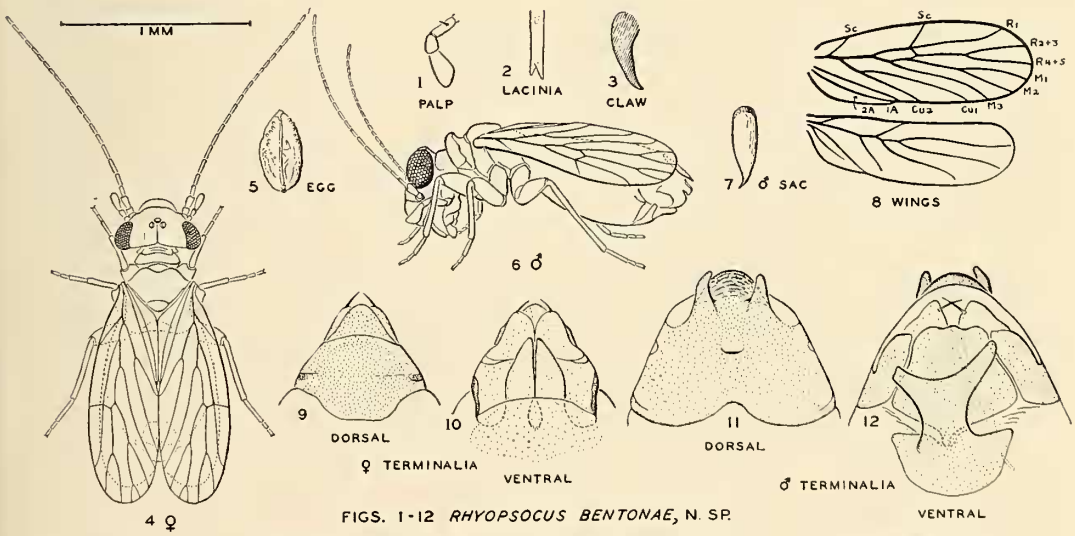
BIONOMIC NOTES

The following preliminary notes on the bionomics of *R. bentonae* were obtained from specimens reared under somewhat unnatural conditions. This rearing technique was used with good results for *R. bentonae* and these other household species: *Psoquilla marginepunctata* Hagen, 1865, *Psocatropos lachlani* Ribaga, 1899, *Ectopsocus* sp., and several species of *Liposcelis*. Some difficulty was encountered with the first instars of *P. lachlani*. The equipment consisted of small glass tubes 30 mm long by 9 mm in diameter, which had been cut from dental tubes. These were placed in half-inch wire mesh (hardware cloth) racks with screen bottoms, which were stacked in a quadrangular aquarium containing a little water below the racks. The aquarium was covered by a plastic tray with rounded corners which allowed an interchange of air and moisture, and the whole was kept at uncontrolled room temperature which fluctuated daily during September to mid-October when these preliminary observations on development were made, the extremes being 71° and 85°F.

The food was composed of the following ingredients (the recipe furnished enough medium to coat the ends of 200–300 corks): One teaspoon of dry solids, consisting of equal parts by volume of dried yeast, dehydrated mashed potato, starch and dehydrated skim milk, was added to one teaspoon of water and mixed well. Some of this mixture was smeared on the small end of each cork. The corks were put in a covered pan on a hot plate and heated until the medium was a pale brown. They were then stored in jars in the refrigerator.

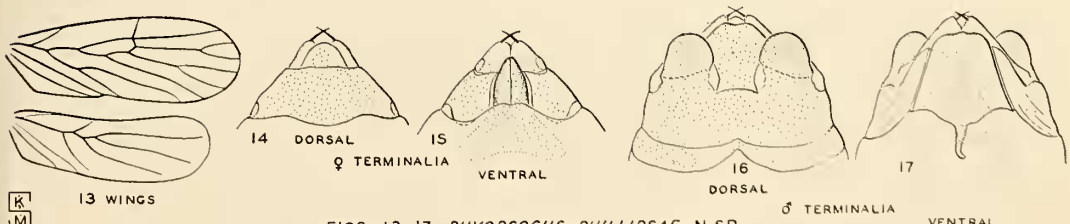
A cork containing the food was inserted in one end of a rearing tube, the psocids introduced and a thin cotton plug put in the other end. The tubes were then placed in the rearing racks. The medium softened in the moist atmosphere and the psocids ate it as well as the mold that grew on it. Eventually some tubes became infested with mites and the psocids retreated to the cotton plugs. Consequently food consumption was reduced and often either the psocids or the mites injured the psocid eggs. If a dead psocid were left in a vial containing more than one psocid, it was eaten by the others.

R. bentonae was an extremely active species,



FIGS. 1-12 *RHYOPSOCUS BENTONAE*, N. SP.

FIGS. 4-8 AND 13 TO SCALE, FIGS. 9-12 AND 14-17 ENLARGED TO SCALE, ALL SETAE OMITTED



FIGS. 13-17 *RHYOPSOCUS PHILLIPSAE*, N. SP.

often darting rapidly and making unexpected starts and stops. The courtship approaches were usually made by the male while rapidly vibrating his wings, which were held in a vertical position. If the female were in a receptive mood she would sometimes flit her wings in a vertical position for a fraction of a second, several times before mating. Occasionally the two psocids approached each other and rubbed palps but such antics were kept to a minimum or dispensed with entirely. Then the male approached the female head-on with his wings held vertically, quickly turned around and backed under the female as she raised her body to allow him to slip under her from the front. He curled the tip of his abdomen up and behind hers and when the genitalia were joined the male sidestepped 180° with the ventral side of the body twisted on the longitudinal axis at about 40° so that usually some of his tarsi were not on the substrate. Copulation lasted an hour on the average (eight timed matings varying from 41 to 73 minutes), and during this time there were prolonged rhythmic contractions of the abdomen of the male. Apparently a considerable amount of fluid was forced into the female abdomen because the dorsal prongs of the male terminalia and the ventral tail-fin-like flap eventually took a viselike grip on the female terminalia as her abdomen became considerably swollen. Toward the end of the copulation period the female sometimes walked around dragging the male behind. Almost immediately after separation the male deposited on the substrate a transparent, slightly curved (upward) carrot-shaped sac, which was drawn to a fine tip at the posterior end. The sac usually contained only a small amount of a transparent fluid at the anterior end. To my knowledge this is the first recording of the deposition of a copulatory sac by the male psocids after mating. Apparently it is not uncommon, in one group of psocids at least, because I have observed the same procedure immediately after each mating of *Psoquilla marginepunctata* and *Psocatropos lachlani*. Often the males turned around and ate part or all of the sac, or sometimes the females ate it. The approximate measurements of the sacs were 0.39 by 0.09 mm; these measurements were made through the glass tubes. Fig. 7 was sketched from memory according to averaged measurements. Apparently the psocids have preferences as the female sometimes resisted the approaches of the male and butted him with her antennae, and usually by the next day the antennae of the male were broken off to stubs if he were still alive. Occasionally on the following day the male was dead and partly consumed, but these "fights-to-the-finish" were not observed. However, one such resistant female was placed with another male and mating occurred shortly thereafter.

Mating occurred more than once. Two pairs were observed mating again 31 days after the first time. In one instance a male and female of *bentonae* were kept isolated from each other, but in the company of a *P. marginepunctata* individual of the opposite sex. Both sexes of *marginepunctata* made courting advances upon the opposite sexes of *bentonae* but their efforts were ignored. The two sexes of *bentonae* were put in the same tube for a short time on the 5th, 7th, 11th, and 20th days and each time mating occurred and a sac was deposited by the male. Limited data suggest that fertilized eggs may be deposited for a period of about two weeks at the most, after mating.

Information regarding length of the preoviposition period is lacking, but 9 pairs ranging in adult age from 3 to 6 days mated immediately when paired off. Seven of the 9 females deposited eggs the following day while the other two did not oviposit until 7 days later.

The eggs were deposited singly with little or no pre- or post-ceremonial activity. They were bare, not covered with excrement or silk, and there seemed to be a tendency to place them in depressions. They were most often laid on the cotton plug or on the food, but only rarely on the surface of the glass tubes. If mating had not occurred a reduced number of non-fertile eggs was deposited but they turned yellow and shriveled. The egg totals were recorded for 9 females from mid-October to late December when the temperatures fluctuated between 60° and 80° F. The average number laid was 74, with a maximum of 101. Under the more favorable conditions 5–7 eggs were laid each day, which suggests that perhaps as many as 400 eggs could be deposited by one female under optimum conditions.

The eggs, Fig. 5, are somewhat boat-shaped with a wrinkled chorion which has a distinct center ridge dorsally with an indication of two lateral ridges at the anterior end, each bearing four or more little tubercles. About four days after oviposition the eggs darkened. As they

approached maturity the eyes and also the egg burster, which was stretched across the front of the head could be seen through the shell. At hatching the nymph was ventral side up, with the head at the anterior end of the egg. Hatching occurred 8–10 days after oviposition. Air was swallowed at both eclosion and molting, a practice common among psocids.

The following information on development was obtained from group rearings since the eggs laid each day were allowed to hatch in the vial where oviposition occurred. Only the parents and, later, the newly emerged adults were transferred to a fresh vial each day; consequently the young from each daily "brood" grew up together. Although molts and instars could be recorded, one had to assume that the molting sequence was always the same as development progressed, but such is probably not the case. Most of the eggs hatched without any trouble and it was only after the continued absence of a male that non-fertile eggs were deposited.

The various observations on the nymphal stadia were based on a minimum of 17 and a maximum of 78 individuals. The average duration of the nymphal stage was 19.5 days, the first stadium being 2–5 days, usually 3. The duration of each of the second, third, fourth and fifth stadia ranged from 2–3 days and the sixth stadium was a little longer, 3–5 days, with an average of 4.

Based on observations from early October to January of nine mated pairs, the duration of the adult stage averaged 64 days for the females and 69 for the males with maximum periods of 86 and 89 days respectively. The sex ratio was 1:1. If males were present oviposition continued until a few days before death of the female, assuming that the few females under observation died of natural causes.

SUMMARY

Two new species of *Rhyopsocus* are described, and salient features illustrated for both *R. bentonae* and *phillipsae*. A rearing technique for household species is explained and notes on the bionomics of *bentonae* are given as determined from individuals reared under these somewhat unnatural conditions. Courting and mating are described, and the deposition on the substrate of an almost empty transparent sac by the male immediately after mating is noted. The life cycle is completed in a little more than a month, the duration of the egg stage being about 9 days and the nymphal period 20 days. The females laid an average of 74 eggs and adult life lasted approximately two months.

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Even if we resolve all matter into one kind, that kind will need explaining, and so on for ever and ever deeper and deeper into the pit at whose bottom truth lies, without ever reaching it, for the pit is bottomless.—O. Heaviside.